REFLECTION-INDUCED SOURCE CORRELATION IN SPONTANEOUS EMISSION

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Comment on "Reflection-Induced Source Correlation in Spontaneous Emission"

Drabe *et al.* have recently presented an important and novel contribution to the study of the spectroscopy of partially coherent sources.[1] However, some comments are appropriate with regard to the relationship of their work to Wolf's original theoretical investigations of this subject.[2]

Wolf's analysis applies to quasihomogeneous sources. Such sources have the following properties: (1) Their degree of spatial coherence has the functional form $\mu_Q(\mathbf{r}_1,\mathbf{r}_2,\omega)=g(\mathbf{r}_2-\mathbf{r}_1,\omega)$, and (2) the spectral intensity $S_Q(\mathbf{r},\omega)$ varies so slowly with position that

$$S_Q(\mathbf{r}_1,\omega)\approx S_Q(\mathbf{r}_2,\omega)\approx S_Q((\mathbf{r}_1+\mathbf{r}_2)/2,\omega)$$

whenever $|\mathbf{r}_1-\mathbf{r}_2|\leq l$, l being the effective spatial width of $|g(\mathbf{r}_1-\mathbf{r}_2,\omega)|$, i.e., the coherence length at frequency ω. Under these circumstances the cross-spectral density has the form

$$W_Q(\mathbf{r}_1,\mathbf{r}_2,\omega)\approx S_Q((\mathbf{r}_1+\mathbf{r}_2)/2,\omega)g(\mathbf{r}_2-\mathbf{r}_1,\omega)\,.$$

The source described by Drabe *et al.* consists of an incoherent primary source and its reflection in a plane mirror. This source evidently does not satisfy these requirements.

Further, the authors state that their source violates Wolf's scaling law. This law, which was formulated in Ref. 2, gives a condition for spectral invariance of radiation produced by quasihomogeneous sources. The normalized spectrum of the radiation from such a source will be invariant on propagation if the degree of spatial coherence of the source, assumed to be planar and secondary, has the form $g(\mathbf{r}_2-\mathbf{r}_1,\omega)=h(\omega(\mathbf{r}_2-\mathbf{r}_1)/c)$, where c is the speed of light. The authors support their claim by reference to their Eq. (11). It is clear, however, from the analysis presented in their paper that Eq. (11) represents the cross-spectral density of the field in the *far zone,* rather than the cross-spectral density of the source. The degree of spatial coherence of their source is rather complicated to describe mathematically. However, even if one derived a mathematical expression for it and it was found to have the form of the scaling law, the spectrum of the emitted radiation would not necessarily be invariant on propagation because, as already mentioned, Wolf's result applies to radiation from quasihomogeneous sources. Of greater relevance to the analysis of the radiation from the system described by the authors is Mandel's investigations regarding cross-spectral purity,[3] and more recent studies of the spectral changes produced in radiation from two small partially correlated sources[4] and in the Young interference experiment.[5]

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